Hamiltonian Vortices in Fluid Dynamics

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Abstract

The movement of vortices in a fluid flow is indeed responsible for some of the most fascinating aspects of fluid mechanics such as shear, transport and instability. Vortex structures are extremely common in flows. Everyone has seen a whirlpool form in their sink or by liquid mixing with their kitchen whisk. The largest of these structures are found in atmospheric flows (cyclones, etc.) with gigantic sizes. We can also find very large rotating oceans flows. At an intermediate scale, tornadoes are a very spectacular illustration of vortex structure. The correspondence between vorticity equations and point vortex equations offers the advantage of moving from a system of partial differential equations to a system of ordinary differential equations, the latter being much easier to deal with, especially numerically. In this work, we analysis the Vortices dynamics. We first introduce vorticity using the fluid continuity equation. Velocity field and current function were obtained and motion equations of the vortex points result from integration of the velocity field. Hamiltonian corresponding to the vortex points was given by introducing Hamilton equations. Numerical resolution of the equations system is done and interaction of two or more vortex points in different configurations was analyzed
This work ends with a conclusion which will synthesize the contribution of this work in the understanding of physical phenomena which can be modeled by vortex point systems.

Keywords: Vortices, Fluid Dynamics, Hamiltonian, Numeric

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